Quello Center Working Paper 3/23

Federal-Local Realignments of Broadband Policy and Digital Equity in the United States

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DRAFT. FOR DISCUSSION ONLY.

East Lansing, Michigan

April 24, 2023

Prepared for presentation at the

2023 Urban Affairs Association Conference

Nashville, TN, April 26-29, 2023

Abstract

Since the 1930s, the United States has relied on a distributed system of telecommunications policy in which state and federal agencies contributed to assuring universality of access to telephone service. In the deregulatory spirit of the 1990s and with the Internet considered a borderless technology, federal policy seized the momentum. In the hope that unfettered market forces would drive network expansion and service adoption, the Federal Communications Commission removed historical common carrier regulations from broadband. The strengths and limitations of this policy approach have become visible during the past decade. In response, state and local governments have reclaimed policy initiative and adopted measures to narrow gaps in high-speed Internet access. Federal spending programs during the pandemic and the Infrastructure Investment and Jobs Act of 2021 (IIJA) boosted these efforts by channeling significant funding to state and local programs. Moreover, they embraced digital equity as a policy goal for advanced communications infrastructure. This has further stimulated local and state experiments, creating natural broadband policy experiments across the United States. The paper develops a dynamic, socio-technical framework of technology-society interaction. In this framework, digital equity is an outcome of contradictory technological, economic, and political factors. The paper examines, theoretically and empirically, how the historical realignments of broadband policy have affected digital equity from the late 1990s to the current developments. A complex landscape of improvement and deterioration of digital equity becomes visible, with differential effects on urban and rural areas and socioeconomic groups. The paper uses an indirect approach to analyze the most recent measures. Based on a survey of state and local approaches, it develops typology of the current governance models. This allows us to evaluate, informed by historical evidence, which models are more likely to achieve the envisioned, sustained improvements in digital equity.

Keywords

Broadband Policy, Digital Equity, Federal-State Policy Alignment

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1. Introduction

“Broadband” refers loosely to high-speed Internet access of a quality that is sufficient to support advanced applications and services. Given that digital technology is evolving rapidly, there is no clear threshold beyond which a network connection can be considered broadband. In a major report in 2002, the Computer Science and Telecommunications Board (CSTB) offered two alternative views of how broadband could be operationalized. First, it could be defined as the set of technical capabilities needed to utilize advanced applications that are available at a point in time. Second, looking forward, broadband could be conceptualized as the set of capabilities needed to support the development of next generations of applications and services (CSTB, 2002). A country seeking to expand the frontier of technological opportunities will need both.

However, information and communication network infrastructure deployment and upgrades require high investment. Consequently, communities, states, and countries will have to find a balance between infrastructure capabilities that should be widely available to support current and emerging uses and those highly advanced features that are needed to develop next generations of applications and services. The latter might initially only be available to a smaller set of locations and users before they are deployed more widely across the network infrastructure. In the United States, the definition of services that should be widely available increased five hundred-fold from 200 kilobit per second (kbps) in 1997 to currently 100 megabit per second (mbps) download speed and 20 mbps upload speed.

Multiple fixed and wireless technologies are available that can deliver these speeds in broadband access networks (first- and last-mile connections). These include coaxial cable, a technology utilized by cable television companies since the 1990s to provide broadband access, fiber optical networks, unlicensed wireless technologies such as multiple generations of Wi-Fi, and terrestrial and satellite-based licensed wireless services, such as fifth-generation (5G) and sixth-generation (6G) wireless services. These access technologies may compete against each other (e.g., a choice between cable high-speed Internet access or fiber optical access) or complement each other (e.g., fixed broadband access and home Wi-Fi). The technologies have different technological capabilities, different cost characteristics, and are subject to divergent regulation. Consequently, the advanced communications infrastructure is an assemblage of heterogeneous technologies that evolves gradually and often in an unbalanced way.

Policies seeking to govern the speed and direction of infrastructure development similarly are also multifaceted. In the preamble of the Communications Act of 1934 that, with amendments,

continues to be the main governing law for information and communication infrastructure, the United States committed "… to make available, so far as possible, to all the people of the United States, without discrimination on the basis of race, color, religion, national origin, or sex, a rapid, efficient, Nation-wide, and world-wide wire and radio communication service with adequate facilities at reasonable charges …" (Pub. L. 73–416, Section 1). Originally governing telephony and broadcasting, these principles of universal access today guide broadband policies.

Although the notion of ubiquitous access served as an imaginary for broadband development, there was disagreement in the United States and abroad on the role of public policy. The Great Recession of 2008 and the COVID-19 pandemic sharpened awareness of the prevailing discrepancies in broadband access and the severe disadvantages that are associated with lacking or insufficient connectivity. In response, federal and state policies embraced a broader notion of universal access that includes complementary skills and resources. In the Digital Equity Act of 2021, passed as part of the Infrastructure Investment and Jobs Act of 2021, U.S. Congress established digital equity as a paramount policy goal. It is defined as "the condition in which all individuals and communities have the information technology capacity that is needed for full participation in the society and economy of the United States" (Public Law 117–58, Section 60302(10)).

The next two sections of this paper discuss the demise of the historical policy regime put in place to guide universal service policy and recent realignments of the division of labor between local, state, and federal government. Until recently, the federal government initiated major reforms of broadband policy. During the past decade, state and local governments have gradually taken a stronger role that was solidified by recent federal legislation built on a proactive, collaborative model. Section four of the paper develops a conceptual framework of broadband infrastructure as a dynamic, co-evolving socio-technical system. This allows positioning of the roles and intervention points of public policy and offers an analytical approach to assess the effectiveness of the plethora of co-existing governance measures. Section five discusses the forces that are narrowing digital inequality and those that are aggravating it. It also develops a first, high-level assessment of the strengths and weaknesses of the emerging model. The paper concludes with a discussion of the implications for broadband policy.

2. The demise of the historical universal service regime

Effective, rational governance of broadband infrastructure requires the alignment of three interrelated factors. Governance must be based on a proper understanding of the system to be governed, it must have viable means available to attain the envisioned goals, and it must be politically feasible. Many current policy debates are related to the difficulties of aligning these conditions. As with other information and communication technologies before, structural and social changes during the past decades have undermined the prevailing broadband policy practices (Obar & Wildman, 2015). Realignment requires a fresh look and probably adjustment of the existing tools and the development of new approaches (Bauer, 2022). It also will require additional efforts to coordinate policies across levels of government and between the numerous stakeholders and public interest groups that have become involved in broadband policy.

Since the 1930s, the United States has relied on a distributed system of telecommunications policy in which state and federal regulatory agencies contributed to assuring universal access to communications service. In the deregulatory spirit of the 1990s and with the Internet considered a borderless technology, federal policy seized the momentum and adopted a market-driven approach. The strengths and limitations of this policy approach have become visible during the past decade. In response, state and local governments have reclaimed policy initiative and adopted measures to narrow gaps in high-speed Internet access. Federal spending programs during the pandemic and the Infrastructure Investment and Jobs Act of 2021 (IIJA) boosted these efforts by channeling significant funding to state and local programs.

Many of the instruments available to influence broadband policy evolved from earlier periods. Historically, the telephone system was governed by the common carrier principles encoded in Title II of the Communications Act of 1934 as amended. Like the cost of providing modern broadband infrastructure, the investment required to roll-out telephone service varied widely between densely populated urban areas and sparsely populated rural areas, which were typically much more costly to serve. In response, regulators and service providers developed a complex system of internal cross-subsidies to support network expansion. Above-cost prices in urban areas and for certain types of service (e.g., long distance) generated surplus funds that could be used to subsidize rural areas and low-income subscribers.

When competition was introduced into long-distance and local services and new players entered the market that were not vertically and geographically integrated, this system of internal cross-subsidies became unsustainable. Public policymakers responded by introducing a new

system of intercarrier compensation (Rosenberg et al., 2006) and a new funding model for universal service (Gilroy, 2011). In 1997, the FCC created a Universal Service Fund and the Universal Service Administrative Company (USAC), an independent non-profit company, to implement the new universal service policies. Four main programs were created to fund high-cost areas, low-income populations, and special programs to connect schools, libraries, and rural hospitals. Many states developed their own universal service program to support access to telephone service.

The first generation of dial-up Internet services operated over the telephone network. They benefited greatly from the non-discrimination provisions embedded in the common carrier model and the wide adoption of telephone services. Together with the newly liberalized market for communications equipment they allowed decentralized user groups and online service providers to configure online services on top of the telephone network (Driscoll, 2022). Online services and first-generation dial-up Internet services expanded swiftly. As the connection speed supported by modems and networks gradually increased, new and innovative services could be offered. Network infrastructure and services evolved in a mutually enforcing, synergistic fashion. Higher speed networks could have evolved in the same governance model. However, policy changes in the 1990s put broadband on a different course.

Drafted during the height of neo-liberalism the Telecommunications Act of 1996, the first major overhaul of communications legislation, introduced competition as the overarching organizational principle for the communications sectors. In that spirit, it established that the Internet should remain largely unfettered from state and federal regulation. In the late 1990s, entrepreneurial cable television companies started to digitize their networks and offered broadband access to diversify their entertainment revenue streams. This created a bifurcation in the regulation of Internet access services. If provided by telephone companies, Internet access was treated as a common carrier service, subject to numerous restrictions and obligations. In contrast, if provided by cable companies, it was treated as an information service that operated under a much more flexible, light-handed regulatory framework.

The FCC could have reconciled these discrepancies by classifying cable Internet service as a Title II common carrier service. Instead, it reaffirmed its position that cable modem services should be treated as an essentially unregulated service. In the Brand X case, this issue made it all the way to the U.S. Supreme Court. In a surprising line of argumentation, the Court did not decide the merits of the case but affirmed the power of the FCC to classify communications services as either Title I or Title II. In its decision, the Court relied on the Chevron defense,

which implies deference to an expert agency in matters where the law was ambiguous. With a Republican majority, the FCC subsequently reclassified other broadband access technologies (digital subscriber line (DSL), wireless broadband, and broadband over powerline (BPL)) as information services.

As part of these reforms, policy action had shifted from the state to the federal level. Title II, common carrier regulation had evolved over decades under joint federal and state regulatory oversight. Following the constitutional model of the United States, the FCC was responsible for interstate and international issues and state regulatory commissions for intra-state matters. The telephone network and cable networks fit into this spatial model of regulatory cooperation. However, the Internet, a logical network of networks that integrates a patchwork of heterogeneous physical networks into a seamless, borderless communications platform did not fit this model. Moreover, the policy vision was to keep it largely free of government oversight. This regulatory philosophy and the reclassification of broadband access as information services greatly reduced the role of traditional state regulation in broadband.

Federal universal funding programs were historically designed for common carrier services. They contributed to high-speed Internet access development only indirectly and haphazardly. For example, subsidies to carriers installing phone lines in high-cost areas could also be used to provide DSL broadband access. However, Section 706 of the Telecommunications Act of 1996 had authorized the FCC and State commissions with jurisdiction over telecommunications to "encourage the deployment on a reasonable and timely basis of advanced telecommunications capability to all Americans (including, in particular, elementary and secondary schools and classrooms) by utilizing, in a manner consistent with the public interest, convenience, and necessity, price cap regulation, regulatory forbearance, measures that promote competition in the local telecommunications market, or other regulating methods that remove barriers to infrastructure investment."

Advanced telecommunications capability was defined as "high-speed, switched, broadband telecommunications capability that enables users to originate and receive high quality voice, data, graphics, and video telecommunications using any technology." The Act required the FCC to conduct regular inquiries into the availability of broadband and whether it is deployed in a reasonable and timely fashion. The Act also established a framework to assess whether universal service funding mechanisms should be adapted to support advanced telecommunications. Section 254 of the Telecommunications Act instructed the FCC to establish a Federal-State Joint Board on Universal Service. In its initial recommendation in

1997, the Board did not recommend expanding funding to broadband because it was not yet widely adopted among the population. For more than a decade the FCC inquiries concluded that broadband expanded across the country in a reasonable and timely fashion.

3. Realignment of federal and state policy initiatives

Concerned about the slow pace of broadband expansion, states, municipalities, cooperatives, advocacy groups, and citizen initiatives started to responded to local needs and the perceived failure of federal policy with initiatives to narrow connectivity gaps in a more timely manner (Ali, 2021; Strover et al., 2021). Some of these initiatives utilized legacy agencies, such as state regulatory bodies, but many resulted in the creation of new organizations and programs. Within a decade, broadband policy again developed into a multi-centric, nested system of local, state, and federal players, with considerable bottom-up momentum. In many states, municipalities and townships had remained involved in managing rights of way, which gave them some influence over telecommunications development. Recognizing the Internet as an increasingly critical infrastructure, states and local communities, often supported by private foundations, became involved again. By 2022, all states had some form of broadband program. More than 600 municipalities and upwards of 300 cooperatives were offering Internet access services.

Two crises also change the course of action at the federal level. In the wake of the Great Recession of 2008, U.S. Congress passed the American Reinvestment and Recovery Act of 2009 (ARRA), which directed the FCC to expand universal service programs to broadband. It also included significant federal funding for the expansion of broadband access. ARRA appropriated $4.7 billion for the National Telecommunications and Information Administration (NTIA) to increase broadband access and adoption. In addition, it appropriated $2.5 billion for the Rural Utility Service (RUS) in the U.S. Department of Agriculture. The FCC was entrusted to develop a comprehensive broadband plan, which was released in 2010 after an inclusive stakeholder consultation process (FCC, 2010). Finally, the Act appropriated funds to put together a national broadband map to guide programs.

Starting in 2010, and in response to increasing use of video online, the FCC began to define the quality threshold that constituted a broadband connection more aggressively. In 2010, broadband was redefined as a connection supporting at least 10/1 mbps and in 2015 it was again increased to 25/3, the current official standard. Forward-looking programs such as BEAD aim at 100/20 and 100/100 mbps. Whenever the threshold is increased, the extent of digital

inequality is affected also. Consequently, from 2010 onward the FCC periodic reviews of broadband deployment concluded that it was not reasonable or timely. This continuous adaptation created the challenge that legacy programs, which are typically designed with a five-to-ten-year timeline, may continue to support connectivity that is below the new threshold.

New programs built on the existing funding mechanisms for voice services and the regulatory rules governing inter-carrier compensation (Kruger & Gilroy, 2019; Rosenberg et al., 2006). However, in the new competition-driven environment, the FCC gradually moved away from cost-based approaches to programs that embraced market mechanisms to achieve higher efficiency. Interventions were targeted narrowly to specific areas, functioning as stopgaps in areas which competition and private entrepreneurial initiative did not reach. In 2011, a new Connect America Fund (CAF) replaced the traditional High-Cost Fund and established several modernized programs to support the expansion of broadband with innovative instruments. These include model-based support (i.e., subsidies based on a national benchmark rather than actual cost) and reverse auctions (i.e., the winning bid goes to the operator with the lowest subsidy need).

At the same time, the number of parallel funding programs exploded from four to seventeen, often with widely differing eligibility criteria. High-cost support programs and later the programs in the Connect America Fund typically operate over ten-year windows. It is therefore possible, even likely, that older programs that have lower speed thresholds continue to be funded in parallel to new programs. For example, between 2016 and 2020, the consumer-side Lifeline program supported broadband speeds that were below the 25/3 threshold that had been adopted in 2015. From December 1, 2016, to December 1, 2017, 10/1 was accepted and from December 1, 2017, to December 1, 2018, 15/2. In certain cases, subscribers qualified if they purchased 4/1 service. From December 1, 2018, to December 1, 2019, 18/2; and from December 1, 2019, to December 1, 2020, 20/3. Beginning December 1, 2020, the then-prevailing 25/3 threshold was applied (see https://www.fcc.gov/general/lifeline-program-low-income-consumers).

In August of 2019, the FCC replaced CAF with a new $20.4 B Rural Digital Opportunity Fund (RDOF) “to bring high speed fixed broadband service to rural homes and small businesses that lack it” (see https://www.fcc.gov/auction/904). The reverse auction for the first tranche of support took place from October through November 2020. The effectiveness of CAF and RDOF programs was undermined by known flaws in the 2009 version of the national broadband map. Because of simplifying statistical assumptions, it overestimated broadband availability in rural areas and misrepresented broadband adoption in low-income urban neighborhoods. This

contributed to a misallocation of subsidies. In 2020, in the Broadband Deployment Accuracy and Technological Availability Act (Broadband DATA Act), the FCC received an appropriation to correct the errors. A new, more accurate map ("Broadband Fabric"), based on single serviceable locations, is in development.

Traditional programs to advance broadband were overshadowed by the COVID-19 pandemic and the demand for rapid action it generated. In rapid succession, the 2020 Coronavirus Aid, Relief, and Economic Security Act (Pub. L. No 116–136, CARES Act), the 2021 Consolidated Appropriations Act (Pub. L. No: 116–260), and the American Rescue Plan Act of 2021 earmarked more than $10B for broadband-related programs, much of it for services (e.g., tele-health, tele-education), and to support low-income households that could not afford broadband with the Emergency Broadband Benefit (EBB) program. The biggest boost for broadband was generated by the Infrastructure Investment and Jobs Act of 2021, which appropriated $65B for supply and demand-side broadband programs.

The largest program established by IIJA, the Broadband Equity, Access, and Deployment Program (BEAD), appropriated $42.45 billion to NTIA for subsidies and grants to the states. The Digital Equity Act (DEA) designated $2.75B for three programs that provide funding to promote digital inclusion and advance equity for all. An additional $2.00B was designated to support connectivity on tribal lands and $1B to upgrade enabling middle mile broadband infrastructure. The IIJA introduced an innovative approach to inter-governmental collaboration that might also help overcome problems of decentralized knowledge. BEAD, administered by NTIA, will allocate block grants to states, prorated according to the share of unserved locations in a particular state in all unserved locations nationwide.

However, IIJA and the subsequent Notices of Funding Opportunity (NOFOs) did not completely decentralize responsibility. All programs must be developed under close supervision by federal agencies, something that many states are not used to. Each program has a planning phase, a review and commenting phase during which NTIA can require changes to the proposed plan, and an implementation and review phase. The grant programs establish requirements to monitor "measurable outcomes." For example, IIJA requires that states monitor five outcomes, including the availability of, and affordability of access to, fixed and wireless broadband technology, the online accessibility and inclusivity of public resources and services, and digital literacy. The Act also requires periodic evaluations of the broader community outcomes of improved digital connectivity.

Thus, by 2023, a new balance between federal, state, and local initiatives had emerged. Not only had many states and municipalities developed their own broadband initiatives, but the new federal programs also envisioned a partnership between levels of government that devolved the implementation of programs in the hope that this would allow to better respond to varying local conditions and barriers to network deployment and user adoption. Local and state action had created a diverse landscape of approaches and broadband policy experiments. Current federal, state, and local broadband and digital equity policy initiatives seek to provide some overarching guidance to the plethora of local and state initiatives. It is not clear whether the coordinative push will be sufficient to achieve this or whether the pending programs will further diversify local approaches.

4. Advanced digital infrastructure as a socio-technical system

The present diversity of approaches constitutes an unprecedented natural experiment to learn which approaches produce the envisioned results in specific circumstances. It also offers a unique opportunity to develop foundational knowledge for the development of sustainable digital infrastructure policies that could succeed the present, time-limited initiatives. Prior qualitative (e.g., Strover et al., 2021) and quantitative (e.g., Whitacre & Gallardo, 2020) research was often constrained by incomplete or missing information, including data on specific actions undertaken, outcomes of interest, and relevant contextual factors (e.g., Lobo, 2020). One of the recurring challenges that evaluative research during the past ten years faced was the paucity and poor quality of outcome measures (such as information based on the flawed national broadband map (Grubesic, 2012; Grubesic & Helderop, 2022). Moreover, evaluative policy research often struggles with establishing a baseline scenario against which observations can be compared to obtaining reliable estimates of the effects of interventions.

To develop a robust focused and comprehensive understanding of the interactions of broadband policy with supply- and demand-side conditions and broader outcomes, it is important to assemble longitudinal observations across states and communities. Broadband infrastructure policy is an example of multi-centric, multi-modal governance. Federal, state, and local government interventions coexist with initiatives driven by private businesses, cooperatives, non-governmental organizations, and civil society groups. Numerous instruments aim to influence the decisions of market players and the broader outcomes with societal goals. Although many policies are framed as measures in response to market failure and market

imperfections, the range of instruments and interventions is much broader and includes distributional goals in addition to efficiency goals. In addition, rules and regulations that were not primarily designed for broadband policy, such as environmental impact assessments and rights of way policies, affect the sector.

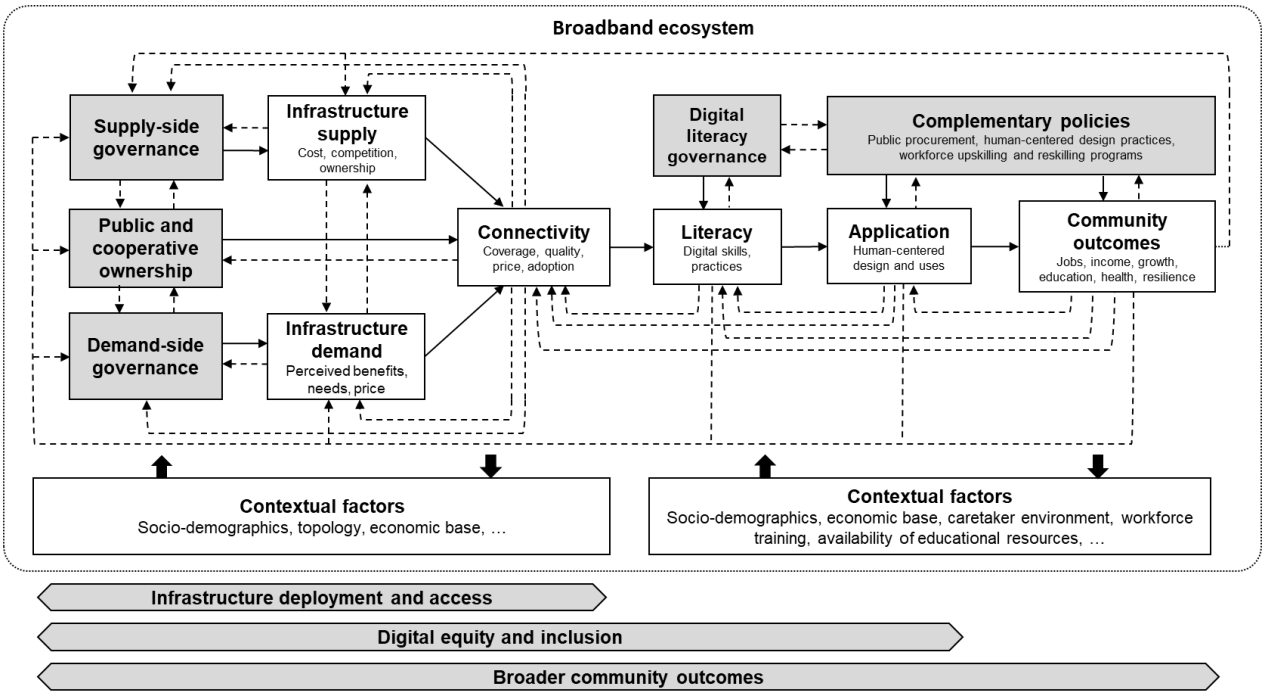

Fig. 1: A stylized model of the broadband access ecosystem. The model reflects key elements of the standard model used in digital inequalities research, augmented with insights from innovation ecosystems and their governance. Solid arrows represent direct effects and dotted arrows represent feedback effects that unfold over time. Our project will explore the relative strength of direct relations and of these feedback effects to develop a better understanding of the inner workings of the advanced broadband ecosystem. We will also develop a typology of broadband ecosystems, reflecting their overall structure and generativity.

The conceptual framework depicted in Fig. 1 is rooted in decades of research examining the factors and relations narrowing and widening digital inequalities (Robinson et al., 2015; van Dijk, 2005, 2020). It is adapted to the programs and policy visions embedded in recent U.S. federal and state legislation. Broadband infrastructure and the broader community outcomes derived from its use are modeled as a nested ecosystem. Broadband connectivity is an emergent outcome of the interaction of supply- and demand-side conditions, which are modified by policy interventions. These interactions constitute the infrastructure deployment and access sub-system. The DEA conceptualizes digital equity and inclusion as a state in which individuals have access to sufficient connectivity, digital literacy and applications. IIJA and DEA see digital equity as a necessary (but not sufficient) condition to achieve broader community outcomes, such as

improved and inclusive education, health care, and civic participation. These interrelated sub-systems are affected by policy interventions and contextual factors that likely mediate how policy interventions translate into outcomes.

Government policy intervenes at several points and in several forms in the broadband ecosystem to influence the development of the network infrastructure assemblage and the broader outcomes enabled by it. Sustained efforts have gone into federal and state programs that affect supply and demand-side conditions. Although smaller in scale, local, state, and the federal government have also invested directly in the development of network infrastructure. With the growing recognition that taking full advantage of digital technologies requires complementary skills and literacy, programs to advance digital literacy were expanded. These efforts received a boost with the programs authorized by ARRA in 2009 and are much more prominent in the most recent federal and state programs, which also strengthen the role of governance to facilitate workforce development and to promote human-centric technology design.

Supply side programs affect the broadband ecosystem by lowering the cost of private, cooperative, or municipal investment. Instruments affecting the deployment costs directly include subsidies and low-interest loans. In some locations, the state or municipalities own broadband network infrastructure (e.g., Chattanooga, TN; Ammon, CO). Numerous public policies that are not primarily designed with broadband in mind, have indirect effects on network deployment. These include measures that reduce the costs of rights of way such as dig once policies or measures to simplify and shorten the process of obtaining permits and environmental impact assessments (e.g., Biedny et al., 2022). In addition, measures that reduce the transaction costs of obtaining rights of way, such as unified state-wide regulations rather than community-specific processes, or regulatory guidelines for access to private sector engineering infrastructures (ducts, poles, antennas) may lower the cost of supply.

Demand side programs reduce the effective price for broadband service and hence shift the demand curve to the right. To make sure the subsidy is used for the intended purpose, some programs, such as Lifeline, directly pay qualifying suppliers after a user signs up. Demand-side programs are tied to the income level of the recipient and, in some cases such as programs in support of Indigenous populations on qualifying tribal lands, to the location. Measures to improve digital literacy and programs to improve the workforce will likely also contribute to a deeper appreciation of the potential benefits of digital connectivity. If this is the case, they may

increase the willingness to pay for services and hence shift the demand curve upwards, all other things being equal.

With only a few exceptions (e.g., Whitacre et al., 2014), most prior research examined this system at one point in time. Such cross-sectional observations provide important insights into associations between factors. Careful research is aware of endogeneities and seeks to control them with statistical techniques. However, these empirical studies often do not capture the dynamic interrelations, the numerous positive and negative feedbacks, between the variables in the system. Developing such models will be an important task in the coming years as it will help to better understand the interaction of factors reducing digital equity and those increasing it at the same time. For example, lower cost broadband access and lower cost devices will likely reduce digital inequality, other things being equal, because they make them more affordable. At the same time, connections and devices with better affordances and capabilities will likely facilitate innovations in new services and applications that may exclude those with insufficient skills, other things being equal (see Fig. 2). The challenge of broadband policy, therefore, is to govern ("tune") the dynamic system in ways that strengthen equity-improving over equity-reducing forces.

5. Digital equity as a dynamic challenge

Universal availability of earlier generations of telecommunications services was not achieved quickly and it was never complete. At peak, household telephone adoption rates hovered at around 90-95% percent, comparable to the current number of Internet users in the United States. The current ambition to achieve digital equity is more broadly construed than earlier efforts that focused on access and the adoption of communication technologies and services. Research on digital inequality has identified three levels of digital divides (access, literacy, uses). As access becomes more ubiquitous, this research showed, that second level (literacy) and third level (uses) divides become more important in affecting broader outcomes for individuals and communities (Bouckaert et al., 2010; DiMaggio et al., 2004; Hargittai, 2021; Hargittai & Micheli, 2019; Van Deursen et al., 2017; van Deursen & van Dijk, 2014; van Deursen & van Dijk, 2019).

These developments are not inevitable. In a dynamic perspective, it is possible that this sequence is reversed as the emergence of new access technologies and devices may reopen digital divides at lower levels. For example, rapid technological change that requires frequent

device upgrades may create new access divides. The introduction of new digital services, such as telehealth or mobile banking, may exclude certain user populations and increase inequalities. Or the introduction of new videogames that require high-quality computing support to run well may exclude many existing gamers who do not have the appropriate equipment and/or the resources to upgrade. A challenge in the present context of rapid technological change is, therefore, to shape technological developments in a human-centric direction. For beneficial services, it will be important to accelerate the adoption of services that are considered part of core infrastructure. Moreover, policy is challenged to provide training and education to develop the skills necessary to participate in technology-enabled activities.

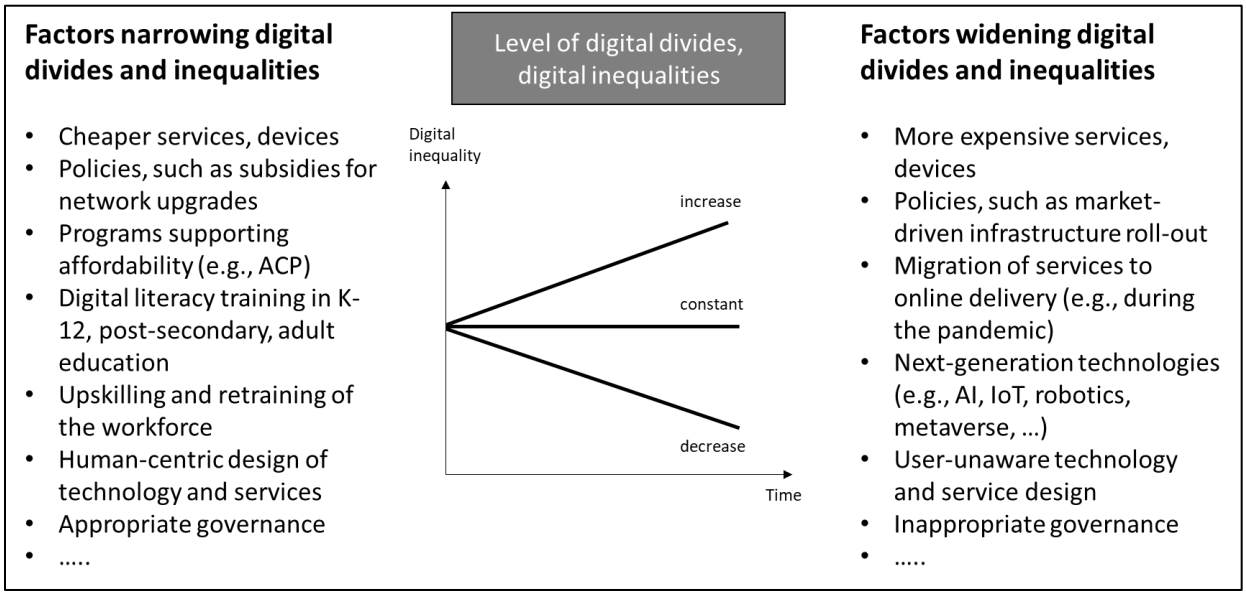

Fig. 2. Forces narrowing and widening digital inequalities. The level of digital inequalities is an outcome of forces working toward narrowing discrepancies and factors increasing them. For example, cheaper service and devices will narrow broadband access divides, all other things being equal. In contrast, higher access prices for service and costs of devices will have the opposite effect. At any point in time, the level of digital equality is an emergent outcome of these multiple, opposing forces in the socio-technical system.

Fig.3 and 4 show the challenges associated with the need to continuously upgrade network infrastructure. The left panel in Fig. 3 depicts the availability of 25/3 terrestrial fixed and fixed wireless broadband across the United States. The right panel depicts the availability of 100/20 service. Despite the level of aggregation, the figure illustrates that inequality of access is, not surprisingly, higher for higher access speeds. This effect is more visible in Fig. 4, which depicts the Eastern Upper Peninsula region of Michigan, a largely rural area. Here, four levels of access speed are differentiated. 10/1 was the broadband threshold in 2010, 25/3 is the current threshold, 100/20 is the threshold for the upcoming IIJA programs, and 1000/100 is the

aspiration level for the near future. A key challenge, then, is for policy to find legal and institutional arrangements that allow upgrading the broadband access infrastructure continuously to these higher standards.

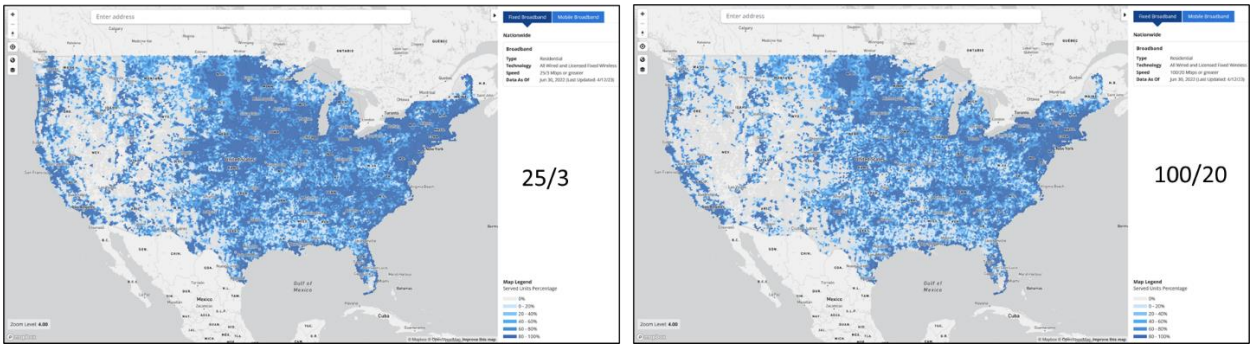

Fig. 3. U.S. broadband coverage at different download and upload speeds. 25/3 mbps (left panel), 100/20 mbps (right panel), based on the preliminary Broadband Fabric. 25/3 service is more widely available than 100/20 service.

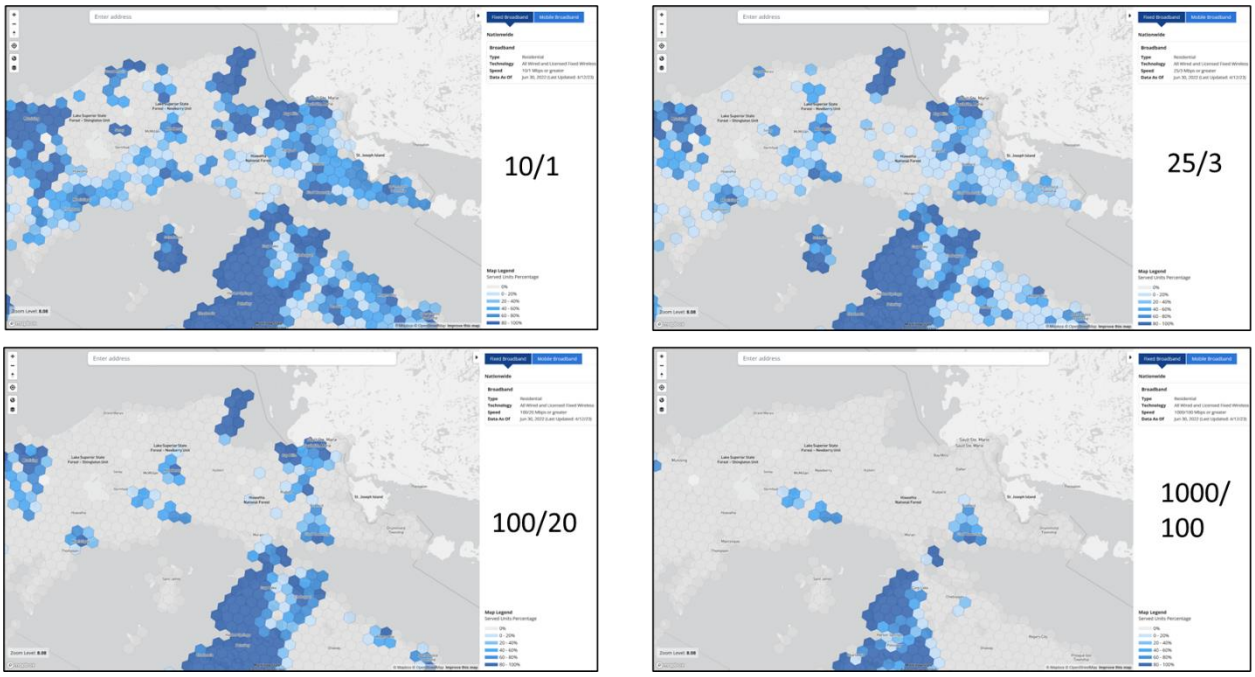

Fig. 4: Broadband access in the Eastern Upper Peninsula of Michigan. Various access speeds as of June 2022, based on FCC Broadband Fabric data.

The market-driven policy regime that was established with the Telecommunications Act of 1996 and subsequent regulatory policies accomplished this goal partially, but it also failed in predictable ways. Between 2000 and 2020, private sector companies invested more than $300B in fixed and wireless infrastructure upgrades. Urban areas, highly educated, high-income

households benefitted from the availability of world-class services. However, entrepreneurship did not suffice to expand service to high-cost, rural and remote areas and did not have the incentives or obligations to provide service to marginalized urban and rural populations, even where networks were available. Policies to close these gaps developed only slowly. Until 2010, under a Republican Administration, the FCC concluded that the speed of broadband rollout was reasonable and timely. This changed in the wake of the Great Recession, which resulted in more proactive policies. The Connecting America broadband plan, released in 2010 established a comprehensive vision for alignment of public and private sector initiatives (FCC, 2010).

Absent action by U.S. Congress, subsequent federal regulatory actions had to build on the legal status quo ante of measures that were designed for telephone universal service. This resulted in the development of an increasing number of specialized funding programs and initiatives, each with its own criteria and administrative rules. One considerable handicap was the erroneous national broadband map and the associated FCC Form 477 reporting process (obliging larger carriers to report network availability and quality data). On the other hand, measures such as the reliance on reverse auctions (in CAF II, RDOF I) contributed to increases in the efficiency of programs. Overall, however, the fragmentation of funding mechanisms and the lack of coordination between programs administered by different agencies translated into a slow closing of the access gaps.

When the COVID-19 pandemic required lockdowns, the full extent of the access gaps and the socio-economic factors influencing were catapulted onto the formal policy agenda. Overnight, the (long-known) fact that nearly 25% of U.S. households did not have reliable high-speed Internet access at home became public knowledge. The extent of the socio-economic divides also became part of the public discourse and awareness increased about how income, race, ethnicity, age, location, and other socio-economic dimensions related to connectivity gaps. Images of schoolchildren completing homework outside fast food restaurants, where they could access free Wi-Fi, sensitized policy for the many repercussions of poor or lacking connectivity. Policy pivoted and adopted numerous needed, short-term, relief measures and eventually a medium-term plan in the IIJA.

Many states and an increasing number of municipalities started to develop their own initiatives to advance broadband. When the IIJA was adopted, a plethora of initiatives and plans had emerged across the country. The Biden Administration and U.S. Congress realized that many of the access problems are local and hence embraced a model that delegated the implementation to lower levels of government. It is too early to assess whether this approach will suffice to close

current broadband access and skills gaps. It is also too early to assess the cost-effectiveness of the programs. The massive amount of funding clearly will have an impact on rural connectivity. It will bring unserved areas online and improve the quality of service to underserved locations. Early estimates suggest it will suffice to connect all unserved locations in most states, except for highly rural states. Complementary programs to advance digital literacy, to provide workforce training, and to develop technical support programs should also move broadband connectivity in the right direction.

6. Conclusion

Democrats and Republicans recognize broadband as a critical infrastructure. However, they have divergent views as to which specific measures will best be able to close the remaining connectivity gaps. This will lead individual states and municipalities in different directions, despite the overarching guidance from the federal government. Even within a state, different initiatives will flourish. Rigorously evaluated, this could help to build a dynamic learning system that could help inform forward-looking policies. One critical, unresolved, challenge will be to create sustainable programs that can accomplish the dual tasks of expanding increasingly capable infrastructures to reach universal connectivity, while allowing differentiation in certain locations to develop next generations of applications. All current programs are time-limited and will expire in four to five years. A model of how such sustainability could be achieved existed in the universal service programs for telephone service. Federal and state policymakers will have a few years of a grace period to devise a sustainable approach. If they fail, the future will see a continuation of cycles of decreasing and increasing digital inequalities.

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